A SPRING CONTACT FOR AN ELECTRICAL CONNECTOR AND A CONNECTOR INCLUDING IT

Background of the Invention

The present invention relates to a spring contact for a small electrical connector and to a connector including it. The invention finds applications more particularly in the field of telecommunications, especially in the context of miniaturizing mobile telephones. This type of contact is generally, although not exclusively, used to interconnect a battery and a printed circuit inside a mobile telephone, in a reversible manner. More generally, this type of contact is designed for electrically interconnecting any two devices. At present, the surface of a first end of the spring contact is soldered to a printed circuit and its second end has a flexible tongue which is curved over the first end. The flexible tongue can in particular come into contact with terminals of a battery located above the connector including the contacts.

The connectors fitted into mobile telephones are generally in the form of rectangular blocks. This type of connector has housings or compartments which contain the spring contacts. These housings open onto a "lower" first face and an "upper" second face of the connector. The lower face comes into contact with the printed circuit and the upper face comes into contact with the battery. A generally U-shaped spring contact inserted into the housing has two branches or arms and a base or bend of the U-shape interconnects the two branches at one end. The base of the U-shape is in the shape of a circular arc and lies in a plane perpendicular to the planes of the first and second faces of the connector. Each branch is adapted to make electrical contact with a device.

The first branch of the U-shape is fixed, for example soldered, to a printed circuit in contact with the first face of the connector. The second branch forms a boss projecting from the second face of the connector.

The total height of the U-shape is made up of three heights added together. These three heights are defined by the shortest distances between two planes parallel to the plane of the printed circuit and containing points of the spring contact. A first of these three heights is the distance between the point where the first branch is soldered to the printed circuit and the point where the first branch joins the base. A second of these three heights is equal to a chord of the base corresponding to the distance between the two end points of the circular arc. A third of these three heights is the distance between a point on the second branch which is the highest point relative to the base and a point of contact between the second branch and the base. The thickness of the connector is defined by the shortest distance between the first face and the second face and, because the spring contact is intended to be partly depressed within the housing of the connector when it is loaded, is less than the total height of the contact. One example of a connector of the above kind is 3.2 millimeters thick.

The current trend to miniaturization of electronic devices, such as mobile telephones, makes it necessary to reduce the size of the various components of such devices. In particular, connectors included in such devices must be small, for example with a thickness of up to 1.8 millimeters and other dimensions in the usual proportions.

In the prior art, reducing the thickness of the connectors and the total height of the spring contacts that they contain is possible only at the cost of a significant increase in the width or length of the connectors and the contacts. This is because the structure of existing spring contacts means that their total height can be reduced only by altering the first and third of the aforementioned three heights. To retain the technical characteristics of the contacts, reducing the first and third of these heights entails thickening

or widening the contact leaf springs, in particular the leaf spring of the second branch. Widening the contact leaf springs widens the connector overall. Thus the overall volume of the connector cannot be reduced. The structure of existing spring contacts therefore makes miniaturizing such connectors a problem.

To mount it on the surface of a printed circuit, this type of connector is picked up by suction pipettes. These pipettes must come into contact only with areas of the connector where are there no spring contacts. The provision of an area of this kind, which is generally in a central position on this type of connector, necessarily implies an increase in the width of the connector. Consequently, this type of connector is currently picked up by two pipettes, one at each end of the connector. This represents another problem with manipulating prior art connectors.

Summary of the Invention

The object of the invention is to remedy the cited problems by proposing a spring contact, for use in a connector, which is substantially U-shaped and has two branches and a base joining the two branches together at one end, each branch being adapted to make electrical contact with a device.

According to the invention, the two branches lie in two diverging planes and the intersection of said two planes is within the base of the U-shape.

The spring contact then has a total height which is less than that of the prior art spring contact.

To reduce further the total height of the contact, one branch and the base of the U-shape are coplanar.

Furthermore, to simplify connection, the electrical contact of at least one branch is at the free end of said branch.

In a second aspect, the invention provides an electrical connector having a first face and a second face opposite the first face, the connector including at least one housing for receiving a spring contact of the

invention. The housing opens onto both faces of the connector and the spring contact is positioned in the housing so that the plane containing the base of the U-shape is substantially parallel to the plane of the faces of the connector.

The base joining the first and second branches is inside the housing. It has a plane of curvature which is substantially parallel to the first and second faces. Increasing the width of the spring contact implies a small increase in the width of the connector. This is because the contacts are disposed so that the first branches of the contacts on the first face are aligned with the spaces between the second branches on the second face. This reduces the overall volume of the connector, which has previously been impossible.

The connector includes means for guiding the spring contact into the correct position in the housing.

It also includes retaining means for maintaining this correct position.

If it is necessary to use a plurality of connections, the connector includes a plurality of housings receiving respective U-shaped spring contacts.

To keep the volume of the connector sufficiently small, the spring contacts in two adjacent housings are positioned so that they are substantially parallel but the opposite way round, one branch of one contact being adjacent the other branch of the adjacent contact.

The branches of the spring contacts are arranged to produce an area with no spring contacts in the middle of the second face. A suction pipette can be applied to this area. The connector can therefore be picked up by a single pipette.

Brief Description of the Drawing

The invention will be better understood on reading the following description and examining the accompanying drawing. In the drawing, which is given entirely by way of non-limiting and illustrative example of the invention:

- Figure 1 is a perspective view of a connector of the invention,

- Figure 2 is a perspective view of a spring contact of the invention, and

- Figure 3 is a view of the face of the connector of the invention that cannot be seen in Figure 1.

Detailed Description of the Invention.

The connector of the invention has a body 1 which has a first face 2 (seen in Figure 1) opposite from a second face 3 (seen in Figure 3) in respective planes 2.1 and 3.1. The body 1 has housings 4 opening into both faces. Thus a housing 4 has a first entry 5 opening into the first face 2 and a second entry 6 opening into the second face 3. The two entries 5 and 6 are separated by a wall 4.1. The connector includes spring contacts 7, each in a respective housing 4. The body 1 has thickness 8. The thickness 8 is preferably not greater than 1.8 mm. The body 1 has width 9 and length 10. In the example shown, the body 1 has four housings 4 containing four spring contacts 7. In this case, the width 9 is preferably equal to 8.3 mm and the length 10 is preferably equal to 15.3 mm. However, the connector of the invention can have any number of housings each containing a spring contact. The dimensions can be adapted to suit the required number of spring contacts or the required technical characteristics.

The spring contact 7 has a first branch 11 in a plane 11.1 and a second branch 12 in a plane 12.1. The first branch 11 and the second branch 12 are joined by a base 13. The two branches are adapted to make electrical contact with an equipment unit such as a battery or a printed circuit. In the case of mobile telephones, one branch of the contact, here the branch 11, can be permanently fixed to the printed circuit, the battery coming into contact with the other branch, here the branch 12. Once the contact has been mounted in the connector, the base 13 has a plane of curvature 13.1 which is parallel to the two planes 2.1 and 3.1 defined

by the first and second faces. However, it can instead be oblique to those planes. In this case, the expression "plane of curvature" refers to the plane into which the curvature is projected along an axis perpendicular to the first and second faces.

In the invention, the two branches 11 and 12 are in respective divergent planes 11.1 and 12.1 and the intersection I of the two planes is within the base 13 of the U-shape.

Also, in the example shown, the plane 11.1 of the branch 11 and the plane 13.1 are substantially coincident.

The first branch 11 is rectangular with two bayonet-type offsets or steps 14 and 15. The two steps 14 and 15 define three portions of the first branch 11. A first portion 16 consists of the end of the first branch 11. The end 16 is a free end adapted to be connected, and in particular soldered, to a printed circuit. A second portion 17 between the steps 14 and 15 is a plane portion. The portion 17 is adapted to be retained in the housing 4 of the body 1. A third portion 18 is defined between the step 15 and the base 13. The portion 18 is mobile in a plane orthogonal to the plane formed by the portion 17. The portion 18 is mobile relative to the portion 17 by virtue of a hinge formed by the step 15. The step 15 also stiffens the branch 11.

The second branch 12 includes a first area 19 forming a shoulder and a nose 20. A first portion 21 of the second branch 12 is defined between the area 19 and the nose 20. The area 19 hinges the portion 21 relative to the plane of curvature 13.1. The first portion 21 is plane and rectangular. In the example shown, the nose 20 and the portion 21 are adapted to come into contact with one terminal of a battery held against the branch 12 projecting from the second face 3. The nose 20 separates the first portion 21 from a second portion 22 of the second branch 12 by forming a projecting corner such that

the second portion 22 is slightly curved under the first portion 21. The portions 21 and 22 of the second branch 12 are mobile relative to the base 13 in a plane perpendicular to the plane of curvature 13.1. The branch 12 is also mobile in a plane separate from but parallel to the plane in which the branch 11 moves.

The total height of the spring contact 7 is made up a first height equal to the height of the first branch 11 plus a second height equal to the height of the second branch 12. This is because the height of the base is virtually zero, since it is equal to the thickness of the leaf spring constituting the spring contact. The two heights are defined in absolute terms by the shortest distance between two planes parallel to the plane 13.1. The first height is equal to the sum of a height 23 corresponding to the height of the end 16, a height 24 corresponding to the height of the step 14 and a height 25 corresponding to the height of the step 15. The second height is equal to the height 26 of the first portion 21.

The second portion 22 has a height 27. The height 27 is made as large as possible so that the second branch 12 does not exit completely from the body 1. In a different example, the portion 22 could have lugs at one end for retaining it in the second entry 6.

Sub 01 As shown in Figure 1, the spring contact 7 is retained in the housing 4 of the body 1 by retaining means which include lugs 28 holding the portion 17 pressed against a rim 29 of the first entry 5. The lugs 28 are drops of plastics material melted onto the spring contact 7 after it is positioned in the housing 4, for example. The spring contact 7 is inserted into the body 1 via the first entry 5 on the first face 4. The size of the first entry 5 is such that it allows all of the spring contact 7 to pass through it. In contrast, the second entry 6 allows only the second branch 12 of the spring contact 7 to pass through it. The branch 11 is

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retained in the first entry 5 by the wall 4.1. The housing 4 therefore includes a hole leading from the first entry 5 to the second entry 6 whose cross-section is restricted to the size of the aperture of the second entry 6. When an object, for example a battery, is pressed against the second face 3 of the body 1, and therefore against the branch 12 of the spring contacts 7, the branch 12 is depressed, the height 26 is reduced and the portion 22 is depressed into the housing 4. In one example, the maximum travel of the branch 12 is 1.5 mm. The object pressed against the second face 3 must exert a force lying in the range 0.5 newtons (N) to 1.5 N to depress the branch 12 into its housing 4.

The connector has an axis of symmetry 30 orthogonal to the first and second faces 2 and 3 and passing through the center of each of them. The axis of symmetry 30 is a feature associated with the number of spring contacts 7 including in the body 1, and is present only if the connector includes an even number of spring contacts 7.

If several points of contact are required, the connector includes several housings, for example housings 4a, 4b, receiving respective spring contacts 7a, 7b. The contacts are substantially parallel but the opposite way round relative to each other, a branch 11a of one contact 7a being adjacent a branch 12b of the adjacent contact 7b.

The contacts are arranged relative to each other in the body 1 to distribute the steps 20 alternately over the second face 3. This homogenizes the distribution of the ends 16 on either side of the first face 2. The spring contacts 7 are side by side in the body 1. The space between two successive branches 12 on the second face 3 overlies the location on the first face 2 of a branch 11 connected to one of the two branches 12. The position of the ends 16 alternates from one contact 7 to the next. The ends 16 project either from a first side 31 of the first face 2 or from a second side 32 of the

first face 2 opposite the first side 31. Both sides 31 and 32 of the connector are therefore fixed to the printed circuit. Because the connector is therefore fixed more firmly, it is not necessary to provide additional soldered joints to guarantee mechanical location of the connector.

To free up an area 33 on the second face 3 sufficient for a pipette, the spring contacts 7 are disposed in a particular manner. The area 33 is required to be centrally located. It enables the connector to be picked up by a single pipette having a diameter of at least 2.5 mm.

The connector further includes recesses or cavities 34. The cavities 34 are formed in two lateral faces 35 and 36 of the respective sides 31 and 32 of the connector 1 and in such a way that the free ends 16 of the spring contacts 7 inserted into the body 1 project from the sides 31 and 32 via the cavities 34. The ends 16 are therefore visible from the side of the second surface 3 for soldering them. This facilitates soldering the ends 16 to a printed circuit.